Original Speech
Samples s(n)

Compute the LPC Coefficients $\{a_k\}$ *781*

$\{a_k\}$

Initial Gradient
Vector $\nabla_0 E_s = 0$ *783*

Compute the Initial
LSP vector $\Gamma^{(0)}$ *782*

Update the LSP Vector

$$\Gamma^{(i+1)} = \Gamma^{(i)} + \mu_i \nabla_i Es$$ *784*

Compute the
excitation
function u(n) *785*

Excitation   u(n)

Compute the *786*
Synthesized Speech ŝ(n)

$\hat{s}(n)$ s(n)

No

Optimality
Criterion Met? *789*

Yes

Analyze Next
Speech Frame *790*

- *787*
Synthesis Error
$e_s(n) = s(n) - \hat{s}(n)$

Compute the gradient vector

$$\nabla_i E_s = \sum_{k=0}^{N-1} (s(k) - \hat{s}(k)) \nabla_i \hat{s}(k)$$ *788*

Figure 7C: Block Diagram of Joint Optimization of Model and Excitation